Evidence for a Non-$q\bar{q}$, $J^{PC} = 1^{-+}$ State from $\bar{p}n$ Annihilation

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Antiproton annihilation on neutrons can reasonably be achieved by stopping $\bar{p}$'s in deuterium and requiring that the spectator proton have very little momentum. As part of a larger program studying many aspects of meson spectroscopy in $p\bar{p}$ annihilation, the Crystal Barrel Collaboration has also collected a substantial data set from deuterium. Using the Crystal Barrel Spectrometer[1] at LEAR, 52,576 well characterized $\eta\pi^0\pi^-$ events were collected from $\bar{p}n$ annihilation at rest. The spectrometer was run in the "single prong" trigger mode to catch the π^- and the photons were efficiently collected in the CsI callorimeter. These events are shown in a Dalitz plot (Fig. 1).

The isospin selection rules in $\bar{p}n$ annihilation result is a particularly simple Dalitz plot structure. The main components are $\rho(770)$ (the diagonal band) and $a_2(1320)$ (the cross structure). After accounting for these known resonances it is clear that an $\eta\pi$ contribution with the non-$q\bar{q}$ quantum numbers $J^{PC} = 1^{-+}$ is necessary[2] (mass=1400MeV/c^2, width=310MeV/c^2). The sum of the interferences of this $\eta\pi$ P-wave with the other resonances is shown in figure 2. After including this exotic state the overall χ^2 is reduced from 3.1/dof to 1.3/dof.

The mass and width of this $\eta\pi$ state are in close agreement with the 1^{-+} state described by the Brookhaven experiment E892[3]. Our collaboration is also investigating the all neutral branch of this state in $p\bar{p} \to \eta\pi^0\pi^0$.

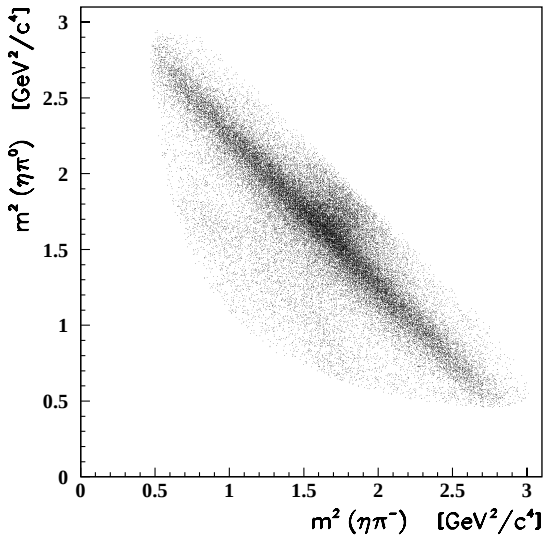

Figure 1: Dalitz plot of the reaction $\bar{p}n \to \eta\pi^0\pi^-$.

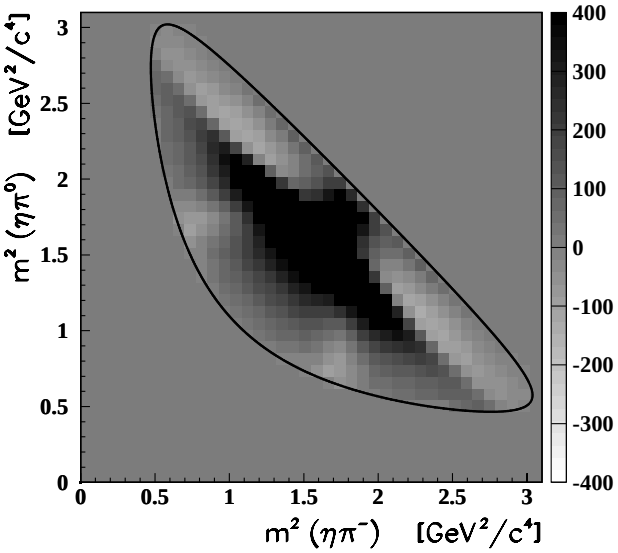

Figure 2: Locations where the 1^{-+} resonance enhances or diminishes the Dalitz plot.

Footnotes and References

*UC Berkeley, LBNL/ Carnegie Mellon Univ./ Univ. of Bochum/ Univ. of Bonn/ Academy of Science, Hungary/ Rutherford Appleton Laboratory/ CERN/ Univ. of Karlsruhe/ Queen Mary and Westfield College/UCLA /Univ. of Munich/ LPNHE Paris/ CRN France and Univ. of Zurich.

[1] E. Aker et al., Crystal Barrel Collaboration, Nucl. Instr. Meth. A321 (1992) 69.

[2] Crystal Barrel Col., accepted, Phys. Lett. B (1998).

[3] D.R. Thompson et al., Phys Rev. Lett. 79 (1997) 1630.